

REDISCOVER PARADISE: ELEVATING BALI'S MARINE TOURISM THROUGH SUSTAINABLE SOLID WASTE MANAGEMENT (SSWM)

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ABSTRACT

As a global tourist destination, Bali's marine ecosystem holds significant value for the leisure industry. However, along with the enormous growth of the industry, the island also faces an imminent waste crisis. As of 2022, 1,085,507 metric tonnes of waste are produced by the island, which 18% of it or 190,726 metric tonnes of waste left unmanaged. Coupled with monsoon and wet season weather that delivers trash ashore, effective waste management holds a pivotal role to preserve the marine ecosystem of the island and its tourism industry. By conducting a qualitative descriptive method, this research proposes sustainable solid waste management (SSWM) as an attempt to combat the waste crisis on the island. This research aims to depict the feasibility – cost, and benefit – of implementing the SSWM. The findings of this research conclude that the implementation of SSWM will benefit the marine ecosystem and further sustain tourism in Bali.

Keyword: Marine Tourism, Waste Management, Solid Waste, Sustainable Solid Waste Management (SSWM)

Introduction

The marine habitat of Bali provides considerable significance for the leisure industry, making it a prominent global tourism destination. Nevertheless, in conjunction with the substantial expansion of the sector, the island is concurrently confronted with an impending waste predicament. In the year 2022, the island generated a total of 1,085,507 metric tonnes of garbage, of which approximately 18% or 190,726 metric tonnes were not properly managed [1].

Bali has gained international acclaim as a prominent tourist destination, widely acknowledged as one of the most sought-after locations globally. Despite the escalating influx of global tourists, Bali has managed to preserve several aspects of its distinctive culture. However, given the island's relatively small size of over 2,000 square miles, the influence of tourism remains substantial. The tourism sector in Bali has a rich historical background, spanning over a century before it achieved its current status as a highly sought-after destination. The tourism sector in Bali has experienced significant growth, leading to its

emergence as a prominent global tourist destination. Bali is renowned for its picturesque coastlines, enchanting temples, and culturally significant landmarks, compelling attractions for global tourists [2], [3]. The tourism business in Bali has a significant level of diversity, with residents making concerted efforts to cater to the needs and preferences of even the most discerning visitors. Nevertheless, Bali must strike a delicate equilibrium within its tourist sector since the detrimental effects of over tourism have the potential to undermine the sustainability and overall well-being of the island [4].

The expansion of the tourism industry in Bali has significantly impacted the marine habitat. This paper examines the deleterious effects of overfishing and detrimental fishing techniques on coral reefs. The tourism industry exploits around 65% of the island's water resources [5], [6]. The beaches of Bali are presently encountering a notable degree of plastic pollution, which presents a considerable threat to the island's tourism industry. Furthermore, there is a pressing apprehension about the phenomenon of

over tourism, which can affect Bali's invaluable natural and cultural heritage detrimentally [2], [7].

Indonesia's tourism industry has substantially impacted the country's gross domestic product (GDP). Nevertheless, the expansion of tourism has been tactically devised with the simultaneous aims of alleviating poverty and safeguarding the environment and natural resources [5].

Furthermore, the rapid expansion of many industries, encompassing mining, agriculture, and forestry, has resulted in adverse environmental ramifications, notably deforestation, soil degradation, and air pollution. In order to ensure the long-term sustainability of Bali's tourism sector and mitigate negative effects on the environment and local communities, the region must actively pursue a state of equilibrium [8].

The waste problem in Bali is a substantial concern with far-reaching consequences for the island's ecological well-being and tourism sector. The presence of plastic pollution in the beaches and waters of Bali poses a significant danger to the island's tourism sector, which heavily depends on the allure of its picturesque beaches and vibrant coral reefs [7], [9].

The trash issue in Bali is a prominent concern that directly impacts the region's environmental aesthetics and cultural legacy, perhaps resulting in over tourism and detrimental effects on Bali's international standing as a popular tourist hotspot. The pervasive lack of awareness about waste management constitutes a prevalent concern that encompasses the entirety of Indonesia, hence making mitigating the garbage crisis in Bali a formidable task [9], [10].

The garbage dilemma in Bali has significant ramifications for the region's marine ecosystem, as it is subjected to the adverse effects of plastic pollution and various other types of waste. The efficacy of Bali's waste management system is suboptimal, and the local government has constraints due to low financial resources, hence posing challenges in effectively tackling the prevailing trash situation [11].

In response to the waste predicament in Bali, the regional administration and non-governmental organizations (NGOs) have undertaken diverse measures, including the installation of trash booms along rivers and beaches, the promotion of

sustainable tourism, and the advocacy for waste minimization and recycling. Nonetheless, resolving the garbage situation necessitates a collaborative endeavor involving governmental entities, local communities, and tourists to safeguard Bali's ecological splendor and cultural legacy for forthcoming cohorts [9], [10], [12].

The main objective of this study is to provide a comprehensive analysis of the pressing necessity for implementing SSWM practices in Bali. The aim is to emphasize the importance of such measures to protect the marine ecosystem and ensure the long-term viability of the flourishing tourism sector. This study used a qualitative descriptive methodology to examine the viability of adopting SSWM by evaluating its associated costs and benefits.

Methodology

This study utilized a qualitative research methodology to thoroughly investigate the waste management issues now affecting Bali's marine ecosystem. This technique aims to examine the waste management difficulties in Bali and its consequences on marine tourism. Incorporating an extensive range of secondary data sources enhances the inclusiveness and reliability of our research. The selection of qualitative approaches was based on their appropriateness for capturing the intricate and intricate nature of the waste dilemma and the wider socio-environmental context in which it takes place.

The primary methodology employed for data collecting in our study involved procuring and examining secondary data sources. The utilization of secondary data, which includes diverse sources such as news stories, scholarly publications, and data obtained from official websites, has yielded substantial information about Bali's waste management challenges. The sources were easily obtainable and conveniently accessible, facilitating a thorough investigation of the topic. The selection of secondary data for this research was based on their direct relevance to the subject of trash management and its influence on the maritime tourism sector in Bali. Utilizing data obtained from credible sources was crucial in ensuring the credibility and validity of the information offered within our study. The primary method employed for data collecting was a

methodical approach to searching and retrieving information from online sources. In light of the contemporary era characterized by digital advancements, the internet assumes a pivotal role as an extensive reservoir of information, rendering it an indispensable tool for scholars and researchers. The researcher employed the subsequent classifications of secondary data sources:

1. News Articles

A comprehensive analysis was conducted on news stories sourced from renowned international and local publications to obtain insights into the prevailing waste management difficulties in Bali. The articles offer current and relevant information about garbage-related incidences, policy alterations, and prevailing public opinions, which assists in comprehending the ever-evolving nature of the issue.

2. Journal Articles

The researchers researched academic journal papers to gain comprehensive analyses, study findings, and expert comments about waste management techniques, and environmental conservation. These academic publications contributed significantly to the research's overarching theoretical foundation.

3. Government Websites

The utilization of data obtained from authoritative government websites, encompassing reports, statistics, and policy documents, played a pivotal role in comprehending the legislative framework and endeavors regarding waste management in Bali. Using government sources was crucial in evaluating the progression of waste management procedures on the island, as they offered valuable historical data.

4. Additional Relevant Online Resources

Additional information and viewpoints on the trash situation in Bali were obtained through consulting a range of internet sources, including reports from environmental groups and publications from non-governmental organizations (NGOs) that specialize in waste reduction and conservation.

The study used the SSWM approach to elucidate the intricacies of waste management in Bali. SSWM encompasses the comprehensive process of gathering, categorising, treating, reusing, and appropriately disposing of waste products while

ensuring minimal negative impacts on the environment, human well-being, and the welfare of future generations. There are several aspects of SSWM as below [13]–[15].

- **Waste Reduction:** The initial measure in achieving sustainable waste management involves reducing trash generation. This objective can be accomplished by implementing measures to minimise the use of single-use plastic products and other materials that do not readily decompose.
- **Waste Separation:** The proper disposal of waste materials can be facilitated by categorising garbage into distinct groups, including organic, recyclable, and non-recyclable.
- **Recycling:** Recycling is the process of transforming discarded resources into fresh products. This approach facilitates the preservation of natural resources and mitigates the accumulation of waste in landfills.
- **Composting:** Composting refers to the biochemical decomposition of organic waste materials, producing a soil amendment that is abundant in nutrients. This approach aids in mitigating the volume of organic waste deposited in landfills while concurrently serving as a source of organic fertiliser for plants.
- **Energy Recovery:** Energy recovery is the process of transforming waste materials into usable energy. This approach facilitates the mitigation of trash accumulation in landfills and offers a sustainable energy resource.

Result and Discussion

1. Current State of Waste Management in Bali

The waste management issue in Bali is an important one experiencing significant growth. However, waste management technology and legislation development must adequately match tropical Asia's escalating waste generation rate. Nevertheless, Bali stands out as an exceptional example where trash generation and awareness are comparatively advanced [16].

The solutions that have demonstrated the highest effectiveness are primarily observed at intermediate scales. It is important to note that a fundamental tension exists between large-scale industrial solutions and small-scale community-based approaches. The Department of Civil Engineering at Bali State Polytechnic has yet to implement initiatives like

recycling, composting, or other integrated approaches for waste management [17].

The garbage produced from teaching and learning activities, practicum, and canteen operations is managed by establishing a reservoir and subsequent disposal into designated trash receptacles. The solid waste management system within the Badung River catchment area encompasses various stages, including waste generation, storage, collection, transfer, disposal, and waste disposal. However, the sorting process and implementing the 3R (reduce, reuse, and recycle) principles need more attention from the local community near the Badung River catchment area [18].

The waste crisis in Bali constitutes a substantial concern that has notable implications for the island's ecosystem and tourism sector. The waste management system in Bali needs to be improved to effectively handle the entirety of the solid waste produced on the island [19].

The coastal areas of Kuta and Legian, renowned tourist destinations in Bali, experience an annual influx of approximately 60 tonnes of plastic waste. The waste management system in Bali is currently facing a structural issue, particularly due to the allocation of cash from local government budgets towards the COVID-19 crisis and the decline in household earnings [9]–[11].

Approximately 50% of the garbage produced in Bali is effectively handled through recycling initiatives and proper disposal in landfills. Furthermore, it is worth noting that the primary landfill in Bali has reached its maximum capacity and is scheduled for closure. Consequently, the responsibility for garbage management will be distributed among the leaders of Bali's 636 villages [11], [20].

The pervasive lack of consciousness about waste management is a prevalent and far-reaching concern that encompasses the entirety of Indonesia, making mitigating the garbage predicament in Bali a formidable endeavor. The plastic waste situation in Bali is exacerbated by inadequate infrastructure, the rapid growth of tourism, deeply ingrained cultural behaviors, and a limited understanding of the plastic lifecycle, spanning from disposal to its eventual presence as marine debris on beaches [10], [20].

In response to the garbage crisis in Bali, the local government and non-governmental organizations (NGOs) have developed various measures to mitigate the issue. These initiatives include the installation of trash booms in rivers and beaches, the promoting sustainable tourist practices, and encouraging waste reduction and recycling efforts. Resolving the garbage predicament necessitates a collaborative endeavor involving governmental entities, local communities, and tourists to save Bali's ecological splendor and cultural legacy for posterity.

2. Feasibility of Sustainable Solid Waste Management (SSWM) in Bali

The management of solid waste is a significant concern in numerous urban regions across the globe. The primary objective of SSWM is to effectively remove waste from residential areas to safeguard public health, considering various environmental, social, and economic considerations. Nevertheless, the viability of SSWM is contingent upon a range of site-specific elements, encompassing both technical and financial aspects. Identifying impediments to SSWM is of utmost importance in enhancing the efficacy of solid waste management practices [21], [22].

When evaluating the viability of SSWM, it is important to examine the following major points [21]–[23]:

1. The integration of SSWM approaches should encompass the entirety of the waste management process, spanning from waste generation through disposal.
2. The involvement of stakeholders is crucial in order to guarantee the effectiveness of SSWM activities.
3. Policy and legislation are of utmost importance in influencing the social implications and fostering stakeholder participation in SSWM.
4. More resources might provide a substantial obstacle in pursuing SSWM.

In the context of SSWM in Bali, the cost analysis can be seen from several factors, such as:

- Capital cost: The primary capital outlay necessary for establishing a waste management system, encompassing expenditures on equipment, infrastructure, and labour.
- Operating cost: The continuous expenses related to the operation and upkeep of the waste

management system, encompassing labour, fuel, and maintenance expenditures.

- Disposal cost: The expenses linked to the disposal of waste products, encompassing the transportation price and fees for landfill usage.

Moreover, implementing SSWM practices yields many advantages, encompassing environmental, social, and economic dimensions [24]–[29].

Environmental advantages:

1. Reducing greenhouse gas emissions and mitigating climate change are two interconnected processes that are of utmost importance in addressing the environmental challenges we face.
2. Implementing pollution mitigation measures may effectively decrease pollution levels and soil, water, and air contamination.
3. The act of conserving natural resources and minimizing the demand for raw materials.
4. Implementing waste reduction strategies leads to a decrease in the volume of garbage disposed of in landfills and incinerators.

Social advantages:

1. Enhance public health and the subsequent mitigation of disease transmission.
2. The mitigation of odors, pests, and litter contributes to improving community well-being.
3. The initiative offers employment prospects for rubbish pickers and other individuals engaged in the waste management industry.

Economic advantages:

1. The organization derives income from commercial transactions involving the exchange of recyclable materials.
2. The implementation of trash disposal and management practices leads to a reduction in associated costs.
3. Promotes the advancement of a circular economy and the establishment of novel enterprises and industries.

In general, the issue of SSWM is of utmost importance, but its viability is contingent upon a multitude of elements peculiar to each site. In order to enhance the effectiveness of SSWM, it is imperative to consider the entirety of the waste management process, engage stakeholders, and formulate laws and regulations that promote social impacts and stakeholder involvement. Implementing SSWM practices can significantly contribute to attaining the United Nations Sustainable

Development Goals (SDGs). These contributions include enhancing the well-being of communities, mitigating environmental pollution, and fostering economic growth and development.

Based on the data mentioned above, it is demonstrated that SSWM can provide viable solutions for waste management in Bali by considering several essential variables.

Comprehensive Approach: The SSWM promotes a holistic approach to waste management encompassing all stages of the waste lifecycle, from waste generation to disposal. Adopting a holistic strategy is crucial in Bali, where there is a growing trend in waste generation. Implementing trash reduction, reuse, recycling, and correct disposal strategies within the framework of SSWM can contribute to the enhanced management of the escalating quantity of waste.

Stakeholder Involvement: This is a crucial aspect of SSWM, encompassing the active participation of stakeholders such as local communities, government agencies, and tourists. In the context of Bali, where waste management understanding is deficient, the active participation of communities and visitors in waste reduction and recycling endeavors can play a pivotal role in bolstering the effectiveness of SSWM projects.

Policy and Legislation: SSWM underscores the significance of policy and legislation in driving waste management methods. The government of Bali has the potential to assume a pivotal position in implementing and enforcing rules to foster responsible waste management. Policies promoting waste reduction, recycling, and the construction of recycling centers might align with the principles of SSWM.

Resource Allocation: This is a critical aspect of effective management, as highlighted by SSWM. Although the availability of resources may present a difficulty, it is imperative to ensure that sufficient resources are allocated. In the context of Bali, where the issue of waste management has reached a critical level, allocating resources towards the construction of SSWM infrastructure and implementing public awareness programs is a prudent investment for the long-term sustainability of the island.

Conclusion

In summary, the waste crisis in Bali represents an urgent and formidable challenge that poses substantial risks to the island's marine ecosystem and its flourishing tourism industry. The increase in tourist arrivals and the concurrent rise in waste production have given rise to a pressing demand for efficient waste management strategies. In 2022, Bali generated a total trash volume above 1 million metric tonnes, a significant proportion of which remained unmanaged, compounding the prevailing crisis.

The adoption of SSWM presents itself as a compelling strategy to tackle the waste management issues holistically faced by Bali effectively. The present study has employed a qualitative research approach and relied on secondary data sources to investigate the viability and advantages of SSWM in the specific setting of Bali. The results highlight several important aspects, including the adoption of a holistic approach, active engagement of stakeholders, the development of appropriate policies and legislation, and the allocation of resources.

Moreover, the research has underscored the environmental, social, and economic advantages of SSWM. The implementation of SSWM practices has the potential to make significant contributions towards the reduction of greenhouse gas emissions, the mitigation of pollution, the conservation of natural resources, the enhancement of public health, the improvement of community well-being, the creation of employment opportunities, the generation of income from recyclable materials, the reduction of waste disposal costs, and the promotion of a circular economy.

SSWM presents a feasible and all-encompassing resolution to the waste management predicaments faced by Bali. In order to preserve the marine ecology and promote the long-term viability of Bali's tourism industry, it is essential to foster cooperation and coordination among governmental entities, local communities, and tourists. Through adopting SSWM strategies and proactively resolving the waste dilemma, Bali has the potential to sustain its position as a renowned international tourist destination while safeguarding its remarkable ecological beauty and cultural heritage for future generations.

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